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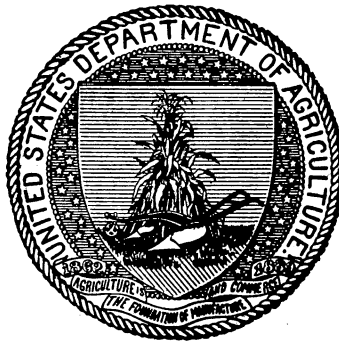
U. S. DEPARTMENT OF AGRICULTURE.

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HOW TO PREVENT TYPHOID FEVER.

BY

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INTRODUCTION.

Current medical literature contains many references to highly satisfactory results obtained by the use of antityphoid vaccine in the reduction of typhoid mortality. The value of antityphoid vaccination has been investigated by specially appointed commissions in England, Germany, France, and the United States, and in every case their conclusions have favored the adoption of this prophylactic measure.

The prevalence of typhoid fever in practically every section of the United States makes any measure which will protect the individual or assist in preventing the spread of the infection extremely important to the community. The production of artificial immunity against this disease by antityphoid vaccination constitutes such a measure, and it is destined to render real service, especially to those about to enter conditions in which they will be unduly exposed to the disease.

The safety and certainty of vaccination as a method of protection against the disease have been conclusively demonstrated during the last 10 years on a large scale by the experiments of the Japanese Army, the English Army, and more recently the United States Army.

The method of applying this prophylactic is very simple. The initial discomfort is not more than that caused by an ordinary hypodermic injection, and the subsequent brief reaction is usually less than in a case of vaccination against smallpox. Inoculation is deemed unnecessary for old people, for very young persons, and in general for civilians who live at home; and it is inadvisable for people in ill health. But for well persons exposed to the dangers of field service it is urgently advised that the regulation three inoculations of the United States Army be taken.

These inoculations are made at intervals of 10 days, the entire course thus requiring 20 days. The injection is always made under the skin—not into the skin or muscle—and the site usually selected is the arm.

It is a well-known fact that a great many cases of typhoid fever occur among the men engaged in the field work of this department, causing inconvenience and loss to the service as well as to the individual. In one bureau during the last 10 years there have been 28 cases and 5 deaths from this malady. Messrs. Page, Mohler, and Smith were therefore appointed a committee, representing the bureau chiefs, to draw up a plain statement of the nature of typhoid fever and the means of preventing it. The statement they have prepared was originally intended for the benefit of members of the Department of Agriculture only. In view of the widespread ravages of this disease, however, I am impelled to make the statement available to the general public also.

Those members of the department who desire the treatment should make application to the chiefs of their respective bureaus, who

will in turn refer such applications to the Surgeon General's Office. The Surgeon General's Office will send the prophylactic in the necessary quantity, with instructions, so that any competent physician can properly apply it.

Physicians desiring to use the vaccine in general practice may obtain it in the same manner in which they now obtain diphtheria antitoxin or vaccine for the prevention of smallpox, inasmuch as a number of biological firms well known to physicians and druggists are now licensed under the Federal law to engage in the preparation and distribution of antityphoid vaccine.

JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *November 7, 1911.*

HOW TO PREVENT TYPHOID FEVER.

THE DANGER FROM TYPHOID.

Typhoid fever is a communicable disease, more to be dreaded on the whole than smallpox, because at present in countries which practice vaccination smallpox is a disease which occurs only occasionally and is soon stamped out, whereas typhoid fever prevails widely in all civilized countries, attacking by preference the young and middle aged, and causes not only many deaths every year, but great economic losses. Serious impairment of the heart and other organs may persist after recovery. In recent years the subject has been brought home to this department by numerous cases among its members, and it has been thought desirable to put on record a plain and trustworthy account of the way in which the disease is usually contracted and what methods may be employed for its prevention.

The disease is not contagious in the ordinary sense of the word, i. e., it is not usually spread from person to person by touch, as in the case of scarlet fever or smallpox. Careful nurses seldom contract the disease. Generally it is distributed indirectly, the person who contracts the disease having in some way swallowed some of the germs derived from a previous case.

The disease is now generally believed to be due to a schizomycete known as *Bacillus typhosus*. This germ causes ulcers on the intestinal walls and also multiplies in other organs of the body, notably the spleen and kidneys. The virus of the disease, i. e., the germ, is discharged from the body in great quantities through the bowels and also through the kidneys, and the discharges from these organs are the source of subsequent infections in other persons. The disease is usually contracted by drinking infected water, but may also be acquired through infected milk, salads, or other uncooked foods. Many wells, springs, and small streams are infected for longer or shorter periods, especially during the autumn and early winter. It is not safe to drink at such places without certain knowledge of the conditions.

Some very severe epidemics of typhoid fever have been definitely traced to contaminated water supplies, both in this country and in Europe. For instance, in an outbreak at Plymouth, Pa., more than a thousand cases of disease resulted in a small community from throwing out the bowel and kidney discharges of a patient upon frozen soil in the vicinity of a stream from which the town was furnished with water. A spring rain washed these discharges into the stream, and soon after the whole community was infected.

The danger from milk is not due to contamination from the cow, because cattle do not suffer with the disease. Milk is infected only when contaminated water is used dishonestly to dilute it, or when the pails and cans are washed inadvertently with such water, or when the germs enter it from the hands or other parts of the body of persons who either expel them chronically or who have been associated with active cases of typhoid. One great danger about milk is that typhoid

germs multiply actively in it without perceptibly changing its appearance. Some years ago at Harpers Ferry an outbreak of 15 or 20 cases of typhoid fever was traced to one milkman whose daughter was very ill of typhoid. This man nursed the daughter, milked the cows, washed the cans, and delivered the milk. Typhoid sprang up all along the milkman's track.

It is believed that the common house fly frequently carries on its body from filthy places the germs of typhoid fever and deposits them on food in kitchens and on dining tables. Those who nurse the sick and are careless about disinfection frequently infect themselves by soiling food or drink with their dirty hands. The fingers should not be put into the mouth, the sick should not be kissed, and the utensils used in the sick room, such as plates, spoons, etc., should be reserved for the sick and thoroughly scalded on removal from the room. The time between infection and the appearance of the disease is usually from 9 to 14 days.

The number of cases in the registration area of the United States every year amounts to about 130,000, and the deaths amount to 13,000, while in the entire United States it is estimated that there are about three times this number.

In 20 years (1890-1909) in the English army in India there were 26,510 cases of typhoid fever and 6,494 deaths.

The proportion of deaths to cases varies from 10 per cent or less in light epidemics to 30 per cent or more in severe ones.

The best methods of avoiding the disease may be grouped under two heads: Personal hygiene and preventive inoculation.

SANITARY MEASURES.

When one is compelled to live in a house or in a neighborhood where typhoid fever prevails he should make it his infallible rule to eat and drink only such foods as have been recently heated to above the scalding temperature. Salads should be avoided, and water and milk should always be scalded before use. Fruits should be pared. The typhoid-fever organism is very susceptible to heat, and slight boiling or even a good strong scalding is sufficient to destroy it. So far as possible the house fly should be screened out of the house, while any that gain access should be diligently pursued and destroyed. A bit of wire netting attached to a wooden handle is a convenient weapon. If these measures were consistently practiced a large part of the now generally prevalent typhoid fever could be prevented, especially if in conjunction with these measures the discharges of the sick were consistently and thoroughly disinfected before being thrown out upon the soil or into latrines.

In many cases the typhoid organism persists in the bowel discharges and in the urine for quite a number of weeks after recovery, so that great care should be taken for a month or two that these discharges are not allowed to contaminate soil or water. In the case of a few unfortunates known as typhoid carriers, the organism becomes acclimated, and these persons then are a source of constant danger to their fellows.

To bowel and kidney discharges should be added an equal volume of 5 per cent carbolic acid solution (poison) or 5 per cent solution of liquor cresol compound (United States Pharmacopœia). Soiled linen

should be put at once into boiling water. Soiled hands should be washed for five minutes in mercuric chloride water (1:1000) colored with methylene blue to distinguish it from ordinary nonpoisonous fluids and kept out of reach of children and animals. Tablets of this character are on the market. In no case should mercuric chloride solution be put into metallic vessels, as it soon becomes inert.

Owing to the difficulty of carrying out these sanitary precautions in localities where house flies swarm and bad water is prevalent and the local sanitary conditions are unknown, it is advised that field men receive preventive inoculation. This advice will hold for all well persons who find themselves in such situations.

VACCINATION AGAINST TYPHOID FEVER

Typhoid fever is a self-limited disease. By this it is meant that if the patient does not die during the progress of the disease the body reacts against the invading micro-organisms with the production of various antibodies known as agglutinins, opsonins, etc., and these antibodies limit the disease to a variable number of weeks, after which the person recovers and the virus (the germ) disappears from the body.

The preventive inoculation for typhoid depends upon this fact. In recent years it has been discovered that by injecting under the skin a small quantity of a dead typhoid culture of known strength the body would react against these organisms in the same way as against the living bacteria in the bowels, and with the same result, namely, the increase in the body of antibodies which persist for a considerable period, rendering the person resistant to the disease.

This method has now been practiced on a large scale, chiefly in the armies of various nations, with striking results. It failed in the English Army during the Boer war, when there occurred 57,684 cases of typhoid fever and 8,020 deaths. But the cause of this failure is now well known. It was supposed at that time that the inoculated men were protected by the inoculation, but it is now known that the temperature at which the typhoid cultures were killed for these inoculations was too high (60 to 65° C.). It has been demonstrated repeatedly since that date that cultures killed at this high temperature lose almost all their protective power, and the bacterial cultures now used are sterilized at a temperature 10° lower (53° C. for 1 hour).

But in other places, for instance in the Japanese Army at the time of the Japanese-Russian war, the results were very striking. The Russian Army was largely incapacitated by fever, while the Japanese Army had practically no cases of fever.

Recently in the British Army in India typhoid inoculation has been practiced on a large scale, and very careful records have been kept of all the cases occurring among about equal numbers of non-inoculated and inoculated soldiers in the same regiments and subject to the same conditions. We now have records for 20 such regiments, and they show that even including one regiment which was inoculated with cultures heated too high the troops which had been inoculated have suffered very little from typhoid in comparison with the uninoculated.

If we exclude this one regiment and consider the regiments inoculated with cultures subjected to a minimum quantity of heat, there have been about ten times as many cases among the noninoculated

as among the inoculated troops. If we include this regiment, about five times as many cases occurred in the uninoculated. In 20 of these regiments there have been 16 cases and no deaths from typhoid fever among the inoculated men (8,754) and 68 cases with 14 deaths among the uninoculated men (7,376).

Similar striking results in the United States Army have been obtained in recent years. Inoculations have been made compulsory, and everybody has been inoculated, from the Secretary of War down. It is a well-known fact that, previous to this, typhoid fever caused extensive loss in our Army, both in our Civil War and in the Spanish-American War. For example, in 1898, in the Seventh Army Corps, stationed at Jacksonville, Fla., consisting of 10,759 men, there were 1,729 undoubted cases of typhoid fever, and 2,693 additional cases of fever believed to be typhoid, making a total of 4,422 cases, with 248 deaths. In the recent maneuver at San Antonio, Tex., there were 12,801 men, all inoculated. Among these men there was only 1 case of typhoid fever, no deaths. In addition there were 2 cases of typhoid fever among civilian teamsters who refused to be inoculated. The 1 case in the Army was a sergeant who received only two doses of the prophylactic, three being the proper number. His disease was so mild that it was only identified as typhoid by means of blood cultures, after the rule had been established to examine all cases of fever lasting more than 48 hours. During this period 49 cases of typhoid and 19 deaths were reported among the citizens of San Antonio. At Galveston, Tex., where a lesser number of troops were also stationed, there were 192 cases of typhoid fever among the citizens and not a single one among the inoculated soldiers. In both San Antonio and Galveston, the troops had large freedom of visiting the towns, and it is quite certain that cases would have developed in the Army but for the inoculations.

Various commissions on antityphoid vaccination have been appointed in England, Germany, France, and the United States to report upon the status of this prophylactic measure, and without exception the conclusions adopted have been to the effect that antityphoid vaccination is useful, without danger, and provides a simple method of diminishing the frequency of typhoid fever.

Old people and very young persons are little subject to typhoid fever. Inoculation is not, therefore, deemed necessary for these classes, and in general for civilians who live at home and are able to care for themselves properly. Neither is it advised for people in ill health. But for well persons exposed to the dangers of field service it is urgently advised that the regulation three inoculations of the United States Army be taken. These should be given always by a competent physician, never by the person himself.

The first dose consists of $\frac{1}{2}$ c. c. ($7\frac{1}{2}$ minims), the second and third doses of 1 c. c. (15 minims) of a young sterilized typhoid culture. The inoculations are made at intervals of 10 days; the entire course thus requires 20 days. The inoculation is always made under the skin, never into the skin nor into the muscle. The site usually selected is the arm at the insertion of the deltoid muscle. The arm should be cleaned as for any other operation. The Surgeon General's Office recommends washing the arm in tincture of iodine diluted in an equal volume of alcohol, and states that this method of disinfection has

proved satisfactory. The skin is painted with the iodine before and after the hypodermic injection.

The inoculating material is sent in a small glass tube, the surface of which should be washed with an antiseptic before it is opened. It may then be entered by making a few cuts at the top with a clean file. The syringe used should be thoroughly sterilized by boiling immediately before use. The inoculating material should preferably be drawn out of the container by means of the syringe. If it is emptied out into anything else beforehand that receptacle must be sterilized in advance. The syringe and needle should be sterilized by boiling in 2 per cent soda solution. It is best to sterilize the piston separately so that the full length of the barrel shall be exposed to the boiling water. A fresh needle must be used on each man, or if not, it must be plunged in the boiling soda solution to resterilize it.

The most suitable time for administration is about 4 o'clock in the afternoon, as the greater part of the reaction is then over before morning. As already stated, no applicant should be immunized who is not perfectly healthy and free from fever at the time. In case of any man who has fever the inoculation should be postponed until he recovers. This precaution is necessary in order to avoid its administration to men who may be coming down with typhoid or other fevers. It is strongly advised not to drink beer or other alcoholic liquors during and for a day or two after inoculation.

The reaction from the inoculations are two: A moderate local swelling, and a slight general fever. These are of shorter duration and usually much less severe than similar inoculations for smallpox. The entire reaction is over in 48 hours, and during this time severe labor should be avoided. It is stated by the Surgeon General's Office that no untoward results of any kind have ever been noted.

Any of the prophylactic remaining unused should be thrown away, and a fresh vial opened for the day's use. It should be stored in the ice box. Nothing is gained by making the inoculations at closer intervals than the 10 days. The production of large quantities of antibodies does not become evident until 8 or 10 days after the inoculation. It is not believed that there is any increased susceptibility following the first dose, but that increased resistance begins immediately, although the degree of immunity produced is not very high until after a lapse of 10 days.

Women and children should receive doses according to body weight, taking 150 pounds as the unit. The Widal reaction is always positive after the typhoid inoculation. It appears within 10 days after the first dose, and is stated by the Surgeon General's Office to remain positive for six months or a year. Col. Leishman, who has had charge of the preventive inoculation in the British Army in recent years, states that the period of protection lasts for two years and in some cases considerably longer.

The prophylactic will keep, it is said, for six months if stored at a low temperature in the dark, but it is desirable in all cases to use it soon after preparation and to obtain fresh supplies rather than depend upon old stock.

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